Claims

What is claimed is

1. A microfluidic substrate assembly comprising:

a substrate body comprising:

at least one fluid inlet port;

at least one microscale fluid flow channel within the substrate in fluid communication with the inlet port; and

a plurality of sockets, each socket configured to receive an operative component, wherein at least one socket is in communication with the microscale fluid flow channel.

2. The microfluidic substrate assembly of claim 1, wherein the substrate body is a multi-layer laminated substrate.

3. The microfluidic substrate assembly of claim 1, further comprising a housing, the substrate body being positioned in the housing.

4. The microfluidic substrate assembly of claim 1, wherein the substrate assembly is generally planar.

5. The microfluidic substrate assembly of claim 4, wherein the plurality of sockets are located in an upper surface of the generally planar body.

6. The microfluidic substrate assembly of claim 5, wherein the plurality of sockets are located in a grid array.

7. The microfluidic substrate assembly of claim 1, wherein at least one of the sockets is in fluid communication with the microscale fluid flow channel.

8. The microfluidic substrate assembly of claim 1, wherein at least one of the sockets is in fluid communication with at least one other of the sockets.

9. The microfluidic substrate assembly of claim 8, wherein multiple sockets of the sockets have the same configuration.

10. The microfluidic substrate assembly of claim 1, wherein at least one of the sockets is in electrical communication with at least one other of the sockets.

11. The microfluidic substrate assembly of claim 8, wherein at least one of the sockets is in optical communication with at least one other of the sockets.

12. The microfluidic substrate assembly of claim 1, wherein the substrate body further includes at least one fluid outlet port in fluid communication with the fluid inlet port.

13. The microfluidic substrate assembly of claim 1, further comprising a fluid reservoir in fluid communication with the microscale fluid flow channel.

14. The microfluidic substrate assembly of claim 1, wherein the substrate body is formed of PEEK.

15. The microfluidic substrate assembly of claim 1, wherein the substrate body further comprises:

at least one data port; and

at least one data channel within the substrate body in communication with the data port and at least one of the sockets.

16. The microfluidic substrate assembly of claim 15, wherein the data channel is in electrical communication with the data port.

17. The microfluidic substrate assembly of claim 15, wherein the data channel is in optical communication with the data port.

18. The microfluidic substrate assembly of claim 15, wherein the data channel is in electrical communication with at least one of the sockets.

19. The microfluidic substrate assembly of claim 15, wherein the data channel is in optical communication with at least one of the sockets.

20. The microfluidic substrate assembly of claim 15, wherein the data channel is bi-directional.

21. The microfluidic substrate assembly of claim 15, wherein the substrate body further comprises a data output port in communication with the data channel.

22. A microfluidic substrate assembly comprising:

a generally planar multi-layer laminated substrate comprising:

at least one fluid inlet port;

at least one microscale fluid flow channel at each of multiple levels within the multi-layer substrate, in fluid communication with the inlet port for transport of fluid to be tested;

at least one microscale via extending between levels within the multi-layer laminated substrate for fluid communication between microscale fluid flow channels on different levels; and

a plurality of sockets, each socket configured to receive an operative component, wherein at least one socket is in communication with at least one microscale fluid flow channel.

23. The microfluidic substrate assembly of claim 22, wherein the multi-layer laminated substrate further comprises:

at least one data port; and

at least one data channel at each of more than one level within the multi-layered laminated substrate in communication with the data port and at least one of the sockets; and

at least one data tap extending between levels within the multi-layered laminated substrate for communication between data channels on different levels.

24. The microfluidic substrate assembly of claim 22, wherein at least one layer of the multi-layered laminated substrate is formed of plastic and the substrate assembly is operative and fluid tight at a fluid pressure in the microscale fluid flow channels in excess of 100 psig.

25. The microfluidic substrate assembly of claim 22, wherein each of the sockets is in communication with at least one other of the sockets.

26. The microfluidic substrate assembly of claim 22, wherein the microfluidic substrate assembly further comprises a pair of rigid plates, the laminated substrate being sandwiched between the rigid plates.

27. The microfluidic substrate assembly of claim 22, wherein at least one layer of the multi-layer laminated substrate is formed of PEEK.

28. The microfluidic substrate assembly of claim 27, wherein the at least one PEEK layer comprises an IR absorbing species in a concentration sufficient for IR welding of the PEEK layer.

29. The microfluidic substrate assembly of claim 28, wherein a coating layer comprising the IR absorbing species distributed in a binder is disposed on the surface of the PEEK layer.

30. The microfluidic substrate assembly of claim 22, wherein at least first and second layers of the multi-layer laminated substrate are selectively welded to each other to form a fluid-tight seal at least along one microscale fluid flow channel within the multi-layer laminated substrate.

31. A microfluidic substrate assembly comprising:

a substrate body comprising:

at least one fluid inlet port;

at least one microscale fluid flow channel within the substrate body in fluid communication with at least one fluid inlet port for transport of fluid to be tested;

a plurality of sockets, each configured for receiving an operative component and in communication with at least another of the sockets, wherein at least one socket is in communication with the microscale fluid flow channel; and

at least one operative component mounted in a corresponding one of the sockets.

32. The microfluidic substrate assembly of claim 31, wherein the substrate body comprises a multi-layer laminated substrate.

33. The microfluidic substrate assembly of claim 31, wherein the at least one of the sockets is in fluid communication with the microscale fluid flow channel.

34. The microfluidic substrate assembly of claim 31, wherein the at least one operative component comprises a fluid reservoir.

35. The microfluidic substrate assembly of claim 31, wherein the at least one operative component comprises a solid reagent suitable to be dissolved during use of the assembly.

36. The microfluidic substrate assembly of claim 31, wherein the at least one operative component holds an enzyme, catalyst or other reagent.

37. The microfluidic substrate assembly of claim 31, wherein the substrate body further comprises at least one fluid outlet port in fluid communication with at least one fluid inlet port.

38. The microfluidic substrate assembly of claim 31, wherein the at least one operative component is operative as a sensor.

39. The microfluidic substrate assembly of claim 31, wherein the at least one operative component is operative as a light sensor across a microscale fluid flow channel within the substrate body.

40. The microfluidic substrate assembly of claim 31, wherein the at least one operative component is operative as a flow sensor, pressure sensor, thermal or temperature sensor, pH sensor, O_2 sensor, conductivity sensor, acoustic sensor, voltage sensor current sensor chemical sensor, electrochemical sensor

41. The microfluidic substrate assembly of claim 31, wherein the at least one operative component is operative as a sensor for detection based on conductimetric, voltametric, redox, electrochemiluminescent, atomic emission and/or calorimetry detection principles.

42. The microfluidic substrate assembly of claim 31, wherein the at least one operative component is operative as an ultrasonic actuator or transducer across a microscale fluid flow channel within the substrate body.

43. The microfluidic substrate assembly of claim 31, wherein the at least one operative component is operative to generate fluid pressure in a microchannel of the substrate body.

44. The microfluidic substrate assembly of claim 31, wherein the at least one operative component is operative as a valve, pressure regulator, flow regulator, external port or plug, filter, trap or absorbant.

45. The microfluidic substrate assembly of claim 31, wherein the at least one operative component comprises a thermal actuator or a thermoelectric module for heating or cooling.

46. The microfluidic substrate assembly of claim 31, wherein the at least one operative component comprises a device operative:

- as a component to degass (remove dissolved or evolved gases and/or bubbles) from fluid being treated or handled by the microfluidic assembly,
- as a component to excite (e.g., fluorescence), illuminate (absorption source) or irradiate (e.g., microwave reactions or heating) a fluid being treated or handled by the microfluidic assembly,
- as a component that is a miniaturized mass spectrometer,
- as a component that is a NMR or MRI spectroscopy detector (e.g, a flowcell and a microcoil in combination), and/or

- as a chromatographic, electrophoretic, isotachophoretic, isoelectric focusing, field gradient focusing or other separation column or chamber used for focusing and/or elution of molecules, particles, cells, organelles, or other species or objects.

47. The microfluidic substrate assembly of claim 31, wherein the at least one operative component is an impellent device.

48. The microfluidic substrate assembly of claim 31, wherein the at least one operative component is operative to directly contact a fluid in the microscale fluid flow channel.

49. The microfluidic substrate assembly of claim 31, wherein the at least one operative component is one of a micromachined pump, diaphragm pump, syringe pump and a volume occlusion pump.

50. The microfluidic substrate assembly of claim 31, wherein the at least one operative component is operative to induce flow in a microscale fluid flow channel by one of endosmotically and electrochemical evolution of gases.

51. The microfluidic substrate assembly of claim 31, wherein the operative component is permanently mounted in a socket.

52. The microfluidic substrate assembly of claim 51, wherein the operative component is permanently mounted in a socket using potting compound.

53. The microfluidic substrate assembly of claim 31, wherein the operative component is removably mounted in a socket.

54. The microfluidic substrate assembly of claim 31, wherein the operative component is an electronic memory component.

55. The microfluidic substrate assembly of claim 54, wherein the electronic memory component is a read only memory component.

56. The microfluidic substrate assembly of claim 54, wherein the electronic memory component is a read/write memory component.

57. The microfluidic substrate assembly of claim 31, wherein the operative component is a microprocessor.

58. The microfluidic substrate assembly of claim 31, wherein the operative component is an electronic tracking device.

59. The microfluidic substrate assembly of claim 31, wherein each of the sockets not receiving an operative component receives a plug.

60. The microfluidic substrate assembly of claim 31, wherein the substrate body further comprises:

at least one data port; and

at least one data channel within the substrate body in communication with at least one data port and at least one of the sockets.

61. The microfluidic substrate assembly of claim 31, wherein the operative component comprises:

a substrate body defining:

at least one fluid input port;

at least one microscale fluid flow channel; and

at least one operative device.